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ORIGIN AND MEANING OF BLAST-CELLS.

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In the development of metazoan embryos from the egg cell, there constantly comes into view new types of cells, having new functions.

The type of cells which give rise to new forms of cell structures are usually called blast cells.

There are many varieties of these cells known, and the causes of their production are varied in different cases.

In all types of insects, there are found on the hypodermis numerous kinds of spines, which serve for various purposes. Many of these are of giant size, in many cases several hundred times the bulk of ordinary dermal spines.

The peculiar method by which these giant spines arise in certain cases, was discovered in the pupa of a common fly—a *Sarcophaga,* 8 day pupal stage. Perhaps the 6 and 7 day stages would show more completely the critical phases, as at 8 days the spines are well extended and formed.

The examination of hundreds of these spine blast cells at this stage shows a process of cell association; the cells of the hypodermis concerned in this process show usually 3 in number, 2 with their nuclei in contact, and a third smaller cell within the group, but not with its nucleus in contact with the others.

Two dermal cells place their nuclei in contact, each nucleus assuming the spirem stage as in early synapsis; they appear as though about to undergo mitosis, but this does not in this case occur, as the spines mature with the nuclei remaining in this stage.

A third dermal cell on the opposite side also enters the group, this nucleus staying in a resting stage; this third cell enlarges but gives no further evidence of functional activity.

The first and second cells on the contrary, grow to enormous size while their nuclei are in contact; the first cell forming the giant spine, while the second in some cases also produces an aborted spine, showing that it also has been greatly stimulated.

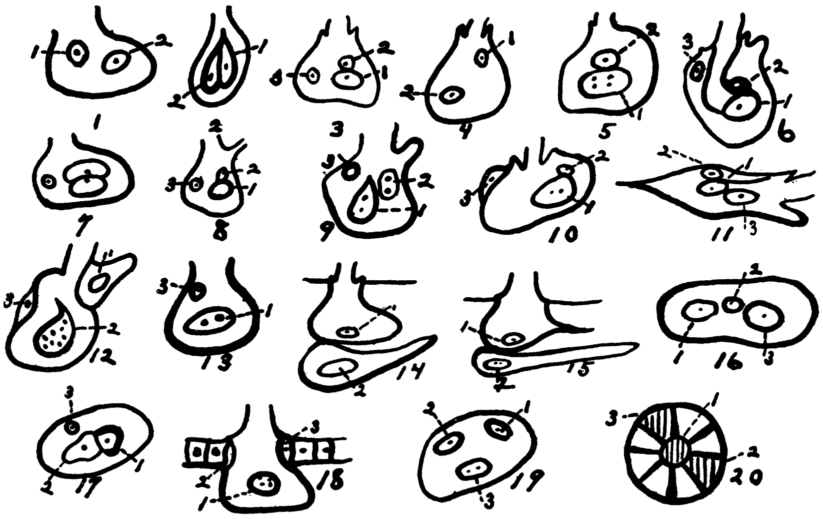

Fig. 1.—Diagrams of Sections of Spine-producing Cells in Sarcophaga.

The sketches from 1 to 20 of Fig. 1, are taken from the specimen at random, and show a variety of views of the spine cell groups.

It should be kept in mind that each peculiar view displays only such characters as the position of the group to the section knife reveals.

From 1 to 15 are vertical sections, while 16-17-19 are cross sections of such groups.

No. 18 is a diagramatic vertical section showing a normal arrangement of the dermal cells, while No. 20 is a surface diagram of a spine cell with its neighboring dermal cells.

The shaded cells are the three cells which form the blast group, and are numbered thus: 1, the main spine cell; 2, the stimulating mate of the spine cell; 3, the minor group cell.

It is very probable that metazoan forms of cell life arose from lower colonial forms of cell life; forms such as Volvox are probably between the two types, and are probably true Mesozoa.

In simple forms of colonial life the individual cells are all complete in their functional activities; while in a mesozoan colony some of the cells have special functional activities, which the other cells do not show.

The origin of these new types of cells is the point now to be considered, and while they show many varieties in the complex animal the different modifying causes may be traced back to three quite general factors.

The first cause of differentiation would probably be conjugation between neighboring cells in a colony, the resultant cell being a hybrid, or possibly a mutant cell differing slightly from its fellows, which cell being of advantage to the whole colony would be conserved by selection.

This mutant cell would as the colony became more complicated give rise to a progeny of cells of its own special structure and function, many of these in turn becoming successive mutants, until as in higher Metazoa we have a multitude of continually differing cells.

The second great cause of variation would be that of nourishment; neighboring cells giving off their products of such kinds and amounts that the special mutating type of blast cell is stimulated to greater growth and activity, or retarded as the case may be, because of the nutritive changes wrought by the cell activities about it.

Such a type is found in many ova, where a jacket of special cells give their nourishment to form the food supply for the future embryo.

Thus we see the food supply may not only have an important part in nourishing blast cells, but it may act directly as a modifying agent, much as Honey Bees by the use of certain foods change the character of the adult insect.

The third great factor in early cell differentiation is doubtless use or function; and while the former two causes precede, this third factor is generally the determining one of the triology which causes the former two factors to reappear in the ontogenetic cycles.

The opposing nuclei of the insect spine cells probably represents a degenerate conjugation or rudimentary sexual affinity.

All the resultant cells from a fertilized egg have these special affinities, so that as is now well known by experiment they seek to re-establish their correct relations when separated from each other. (Roux).

The swarming of the swarm pores in *Pediastrum* and *Hydrodictyon* and their ultimate settlement into their formal colonial arrangement is a good illustration of such an affinity.

Apogamy is the loss of sexual function; when sexual organs though present are functionless, nevertheless the normal product of the sexual act is developed from the oosphere, from the female sexual organs or from its vicinity.

"Thus it occasionally happens with several of the Zygomycetes *(Syzygites)* that the conjugating branches do not unite, but nevertheless they each form at their free extremity a cell which has the properties of a zygospore. The apogamy is still more striking in the case of the Saprolegnieæ, and is constant throughout their entire cycle of affinity. The form of the sexual organs agrees with that of the Peronosporeæ. The antheridia in many cases put out their fertilization tubes, but these remain closed and emit no fertilizing substance. Nevertheless the oospores mature in the usual manner. Other individuals have antheridia, but these put out no tubes; others again have neither antheridial branches nor antheridia, and yet the oospores are developed. In the last two cases we have not only apogamy but a suppression of the sexual organs, which goes still further in the Ascomycetes; for in many of these neither antheridial branch nor archicarp can be distinguished; the fructifications are formed simply by the sprouting and interweaving of hyphal twigs of similar form, some of which are transformed into ascogenous filaments. A parallel case is known also among the Chlorophyceæ, the oospores of *Chara crinita* mature in the normal manner without being fertilized by spermatozoids. Finally in many fungi, especially

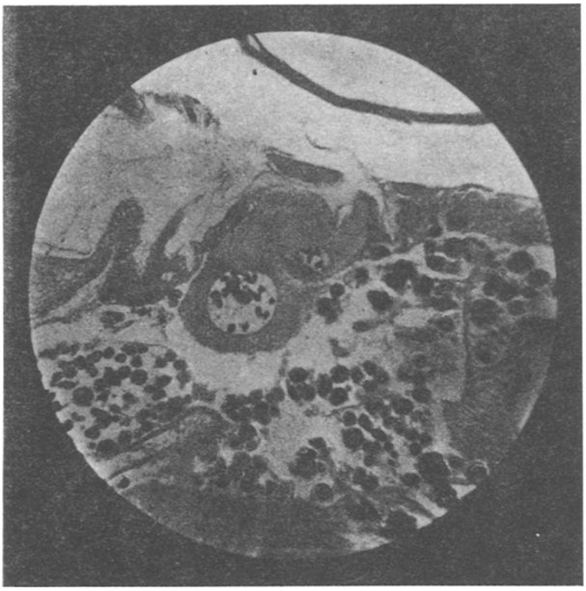

Fig. 2.

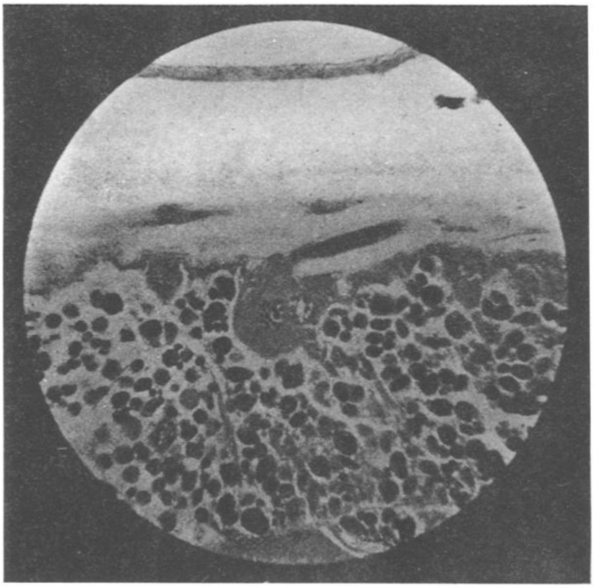

Fig. 3.

Plate I.

Photographs of Cell-associations thru which Spines are produced in Sarcophaga.

in the great division of the Basidiomycetes, the formation of the fructification is altogether suppressed; they have only asexual organs of reproduction." (Goebel).

As all nucleated forms of Protozoa are originally with a complete sexual equipment, it needs but a moment's consideration to see that such cells evolving into colonial and from thence into metazoan forms must preserve more or less modified and degenerate conjugating tendencies.

That all the cells of a group may retain rudiments of their sexual characters, which may on proper provocation be transferred into normal sex organs, is well known from *Coleus* plants, a single piece of leaf being capable of development into a complete plant.

It will thus be seen that the term apogamy should be properly extended to the degeneration of sexual function in all types of cells. Protozoa, Mesozoa and Metazoa, for it occurs in all types of cells in some form.

Thus it seems reasonable to believe that the origin of these different types of blast cells is in a way to be connected with a degenerated and modified sexual function.

There is a need for accurate observation of the nuclei of the early stages of blast cell formation; there is much here to be learned, and the field is not difficult. We should be glad to hear the opinion of others on this subject; it is an interesting one.

Battle Creek, Mich.